

B-1B CONVENTIONAL MISSION UPGRADE PROGRAM (CMUP)



Air Force ACAT IC Program

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| Total Number of Systems: | 93 |
| Total Program Cost (TY\$): | \$2,599M |
| Average Unit Cost (TY\$): | \$10.7M |
| Full-rate production: | |
| Block E: | 2QFY02 |
| Block F: | 2QFY03 |

Prime Contractor

Boeing North American Aviation

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The B-1B *Lancer* is a long-range, swing-wing, supersonic bomber powered by four F-101-GE-102 afterburning turbofan engines. With air refueling, the B-1B can deliver unguided or near-precision guided weapons to targets anywhere in the world. Its defensive avionics system is comprised of the AN/ALQ-161A Radio Frequency Surveillance and Electronic Countermeasure System (i.e., a self-protection jammer) and a tail warning system coupled to a flare/chaff dispenser, and the ALE-50 Towed Decoy System.

The B-1B originally achieved IOC as a nuclear bomber in FY87. The Conventional Mission Upgrade Program (CMUP) began in 1993 to transition the B-1B from a nuclear to a conventional-only role. CMUP changes are intended to enhance conventional weapons delivery capabilities, provide increased situational awareness, increase survivability, and improve supportability. These improvements,

built on *technological innovation*, will equip the B-1B to provide *precision engagement* by attacking strategic and tactical targets at all stages of conflict. With CMUP, the B-1B embraces the key tenets of *dominant maneuver*—rapid, precise, global power projection.

Initially, for a conventional mission, the bomber could carry only Mk-82 500-pound bombs. Block changes carried out under CMUP have upgraded the aircraft's capabilities as follows:

- Block B: Software upgrades to offensive and defensive systems.
- Block C: Capability to deliver CBU-87/89/97 cluster bombs.
- Block D: Communications system upgrades, addition of Global Positioning System navigation capability, and capability to deliver the 2000# GBU-31 Joint Direct Attack Munition (JDAM).

Joint Stand-Off Weapon and Joint Air-to-Surface Standoff Missile weapons integration and two additional blocks of CMUP remain:

- Block E: Upgrade the computers for increased weapon flexibility/better supportability, and integrate the Wind Corrected Munition Dispenser.
- Block F: Upgrade the defensive avionics suite by integrating a radar warning receiver, a radio frequency countermeasures system, and a fiber-optic towed decoy.

BACKGROUND INFORMATION

Test planning for B-1B CMUP is covered by a Capstone TEMP and annexes for each major upgrade. Operational Test and Evaluation phases for remaining CMUP changes are scheduled incrementally as developments are completed and integrated. The TEMP annex for Block D IOT&E was approved by DOT&E on May 29, 1997, and Block D IOT&E test plans were approved on October 30, 1997. TEMP annexes for Blocks E and F have been approved by DOT&E, but will be revised and resubmitted during FY00 due to program restructure.

The B-1B CMUP was placed on the Annual T&E Oversight List for Live Fire Test and Evaluation in December 1993. A waiver from full-up, system-level Live Fire Testing was approved January 1995, together with an alternative plan for meeting LFT&E objectives. The alternative plan called for a combination of testing and analysis and is included in the latest approved TEMP as an annex. B-1B LFT&E tests were conducted using large sections cut from B-1B Number 1, which had been disassembled in accordance with Strategic Arms Reduction Treaty protocol.

TEST & EVALUATION ACTIVITY

Initial Operational Test and Evaluation of the Block D upgrade was conducted at Edwards AFB, CA, from August-September 1998 by AFOTEC. DOT&E submitted a B-LRIP report to Congress in January 1999, prior to the Air Force's decision to enter production for the Block D upgrade.

Force Development Evaluation (FDE) of Block D began in November 1998 at Ellsworth AFB, SD. FDE objectives were to further assess the effectiveness and suitability of Block D changes and

refine concepts for operational employment. FDE activity was suspended early in CY99 because of problems with the new UHF/VHF radio system (see below), and will resume when those problems are corrected.

Operational Assessments by AFOTEC are in progress for Blocks E and F, to provide advance information on issues that may affect planned IOT&E or effectiveness/suitability of the upgrades.

All Live Fire Test and Evaluation testing has been completed. The Air Force completed a consolidated report on B-1B LFT&E in April 1998. A DOT&E independent evaluation was completed and a classified report was sent to Congress in January 1999. The evaluation methodology included a combination of 149 ballistic tests, supplemented with modeling and analysis to assess: (1) overall vulnerability; (2) fuel tank ullage fire/explosion, wing dry bay fire, and fuselage dry bay fire; (3) hydrodynamic ram damage to wing; (4) vulnerability due to on-board ordnance, flight control system, hydraulic system, and engines; (5) crew casualties; and (6) battle damage assessment and repair.

TEST & EVALUATION ASSESSMENT

BLOCK D:

As detailed in the January 1999 B-LRIP report to Congress, contained in the classified Annex, IOT&E of Block D confirmed B-1B CMUP Block D is operationally effective. B-1B demonstrated the capability to load, carry, status check, release, and jettison Joint Direct Attack Munitions from all three weapons bays. A full weapons bay of eight JDAMs was released during a single IOT&E sortie. Performance of the aircraft modifications was successful during 97 percent of the release trials.

Although Block D aircraft modifications were shown to be effective for release of JDAMs, the Mission Planning System was found to be unsatisfactory because it did not account for wind. Additionally, aircrews do not have a display of JDAM Launch Acceptability Region (LAR) information in the cockpit. While maneuvering on an operational mission, the crew may be unaware they have flown outside the LAR, preventing JDAM release.

The overall navigation system upgrades are effective. Global Positioning System for B-1B improved the accuracy of navigation for all missions. Communications upgrades are adequate to perform current conventional missions. However, advanced voice and data capabilities are unresolved and require additional communications test data.

Overall operational suitability of Block D upgrades was found satisfactory. Block D systems showed high reliability during flight testing, with only one critical failure in 685 flight hours. Failure data indicates that Block D modifications will not degrade B-1B's Mission Capable Rate. Additionally, time between failures and repair times met operational requirements.

Maintainability and logistics supportability were unsatisfactory, primarily because of inadequate Fault Detection/Fault Isolation capabilities. B-1B's inadequate Central Integrated Test System, insufficient training, and poor technical orders affected Fault Detection/Fault Isolation. Software suitability was satisfactory except for inadequate documentation for some software components. Operational weapons personnel loaded a full load of 24 JDAMs in about 3 hours, well within the 6-hour threshold requirement.

Block D upgrades require:

- Mission Planning System software improvements to account for wind magnitude and direction for proper planning of JDAM deliveries.
- Mission Planning System improvements to support programming the Communications and Navigation Management System (CNMS) data transfer cartridges.
- Procedures, plans, and a concept of operations for Demand Assigned Multiple Access (DAMA) usage.
- Adequate crew training to operate the complex DAMA system.
- Aircraft software modifications to provide JDAM LAR displays and feedback to the crew.
- Central Integrated Test Systems and technical orders improvements.

DOT&E found that future operational B-1B testing was needed to:

- Evaluate the above improvements (when accomplished).
- Evaluate JDAM release conditions, including low altitude deliveries.
- Verify performance of the production Global Positioning System Antenna System.
- Ensure that navigation performance is not degraded in a jamming environment.

FDE:

Force Development Evaluation testing of the B-1B Mission Planning System, completed in February 1999, found the latest B-1B Mission Planning System (Release 1.01, Version 10.04) unsatisfactory for combat operations due to JDAM planning inaccuracies, including the problem with accurate wind computation cited above. (See Air Force Mission Support System assessment for additional details.) Recent tests have shown that the Mission Planning System is now capable of programming CNMS cartridges.

Force Development Evaluation of B-1B addressed some issues not resolved in IOT&E. JDAM releases were conducted at altitudes lower than those evaluated in IOT&E to verify alternative aircraft software versions. Force Development Evaluation also evaluated the performance of the production Global Positioning System Antenna System and found it to be satisfactory. During FDE, problems were discovered with the power supply for the new Block D UHF/VHF radio high power amplifier and the UHF/VHF antenna. FDE was suspended until these problems are corrected (expected approximately November 1999). Upon resumption, FDE will address additional communications testing, such as the evaluation of Satellite Communications and DAMA modes.

OPERATION ALLIED FORCE (OAF):

During Operation Allied Force, four Block D and one Block C B-1B deployed from Ellsworth AFB to Royal Air Force Fairford in the United Kingdom. During this deployment, B-1Bs flew 74 combat sorties over Serbia and released more than 5,000 Mk-82 500-pound bombs. Although Block D aircraft were also capable of dropping JDAMs, and all aircraft could have dropped cluster bombs, B-1Bs were not tasked for these weapons. Combat sortie durations were seven to eight hours. Some aircraft were rotated during the operation to support schedules for maintenance inspections.

Block D UHF/VHF radios were operated during Operation Allied Force with temporary fixes. Although radio ranges for Block D aircraft were less than Block C aircraft, performance did not negatively impact operations. Mission Planning System software, although rated as unsatisfactory for combat operations, was given a waiver for use during Operation Allied Force. Many workarounds were required by planners and many problems were encountered; however, OAF missions were successfully planned in time to meet schedules.

Although no JDAMs were released by B-1Bs, the Block D Global Positioning System upgrade proved to be very successful during OAF operations. The enhanced accuracy provided by the Global Positioning System allowed bombing on coordinates and significantly improved bomb scores in comparison to radar offset bombing.

BLOCKS E and F:

Combined DT&E/OT&E of Blocks E and F was scheduled to begin in FY00. Block E has experienced slippage due to software development delays. Block F has both hardware and software delivery delays tied to the Navy Integrated Defensive Electronic Countermeasures program. Blocks E and F are both being restructured. Estimates are that Block E IOT&E will start in late FY01 and Block F IOT&E in late FY02.

LFT&E:

The B-1B LFT&E program was adequate to assess the vulnerability of the B-1B to expected threats, the potential for user casualties if the aircraft is hit, and battle damage assessment repair capabilities. The independent assessment revealed significant vulnerabilities related to ullage fire/explosion, dry bay fire, and hydrodynamic ram damage. These vulnerabilities cover a large portion of the aircraft. Technologies that could alleviate these vulnerabilities were identified.

LESSONS LEARNED

Lessons learned during B-1B LFT&E include:

- The use of retired aircraft poses an effective and economical means for obtaining realistic live fire test data for upgrade programs.
- Test instrumentation acquired to measure composition of the ullage was inadequate for accurate determination of ullage constituents.

- The process of scaling small-scale specimen test results to large-scale specimens is not sufficiently understood.